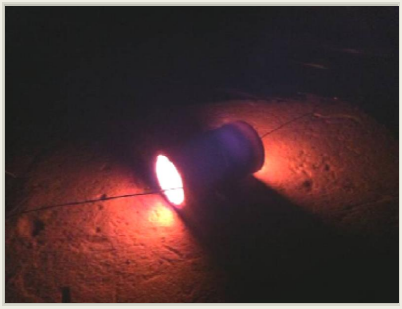
Advanced Ignition System for Hybrid Rockets for Sample Return Missions, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

To return a sample from the surface of Mars or any of the larger moons in the solar system will require a propulsion system with a comparatively large delta-V capability due to the magnitude of the gravity well. Consequently, significant propellant mass will be required. While it is technically feasible to generate O2 and CO propellants by electrolysis of CO2 from the Martian atmosphere, it will only work on bodies where there is significant CO2 in the atmosphere, and the mass of the required infrastructure (electrolyzer, batteries, solar panels) is significant. A recent study has shown that bringing the propellant from Earth is a mass-competitive option. In particular, a hybrid rocket with multi-start capability trades more favorably than either a CO2 electrolysis system or a bipropellant system where the propellants are generated on Earth. Using a high-performance hybrid propellant combination and being able to restart the hybrid rocket are the keys. In previous and ongoing work, Ultramet has demonstrated that electrically heated open-cell silicon carbide foam can be used as an igniter for both monopropellant and bipropellant rocket engines. Due to its low mass and favorable electrical characteristics, the foam can be heated to 1300?C in just two seconds, which enables it to quickly ignite any propellant flowing through it. In this project, the technology will be applied to hybrid rocket engines to give them multi-start capability. A portion of the liquid oxidizer stream (typically oxygen or nitrogen tetroxide) will pass through the foam and be heated such that the high temperature gas leaving the foam will be sufficiently hot to cause spontaneous ignition on contact with the fuel (typically paraffin). Once the engine is ignited, power to the foam heater can be turned off. Ultramet will design, test, and characterize electrically powered foam heaters and perform ignition testing with paraffin fuel grains.



Advanced Ignition System for Hybrid Rockets for Sample Return Missions, Phase I Briefing Chart Image

Table of Contents

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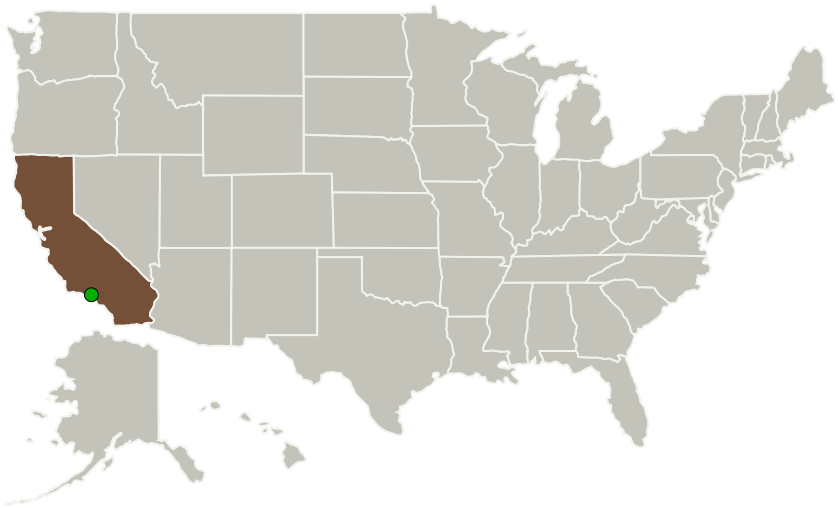
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ultramet	Lead Organization	Industry	Pacoima, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ultramet

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

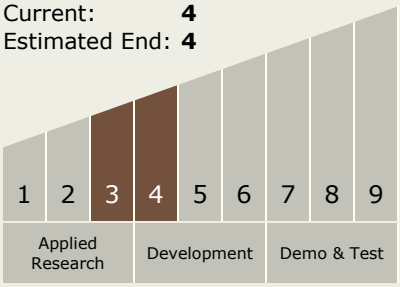
Carlos Torrez

Principal Investigator:

Arthur J Fortini

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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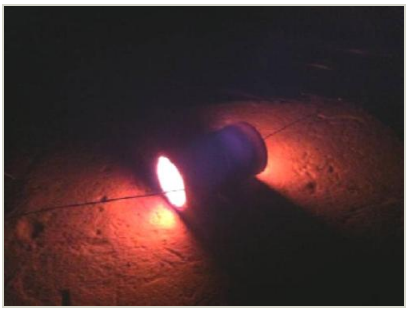
Images



Briefing Chart Image
Advanced Ignition System for Hybrid Rockets for Sample Return Missions, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/132746)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.5 Hybrids

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System